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ABSTRACT

This article, by the IBM (International Business Machines) program manager for the Institute for Academic Technology (IAT), is premised on the idea that the use of computers can help address many of the issues facing undergraduate education today. Computers in the classroom can enrich both teaching and learning. The IBM personal computer and the associated Advanced Academic System for faculty allow educators to put together video, still images, text, voice, music, and graphics for classroom presentations. Computer technology allows college faculty to keep pace with the individual needs of students and prepare them for real-world jobs. Positive changes in teaching are made possible through computers, which can benefit nearly every aspect of faculty work. Examples are given of computer assisted instruction, computer assisted testing, and computer managed instruction. The many benefits make the instructor's time spent in learning computer use well worth it, particularly since one need not be a computer wizard to use the technology. The rapid evolution of innovative educational technology provides educators with the tools they need to stimulate and assist today's learner. (SLD)

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Teaching and Learning with Computers

Diana Oblinger, Ph.D.

TPR-06

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Teaching and Learning with Computers

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Overview

According to some educational leaders, the quality of undergraduate education is not keeping pace with the needs of today's students. Some national projections suggest there may not be enough teaching faculty by the year 2000. Educational costs continue to climb while at the same time disadvantaged and ill-prepared students seek educational opportunities. More subject matter must be crammed into fixed time frames in many disciplines to keep up with advances. Students need more meaningful preparation for real-world jobs. The use of computers can help you address many of these issues.

"Computers in the classroom enrich both the teaching and learning experience"

The IBM PS/2 and the large library of educational and commercial software has had a major impact on instructional computing at colleges and universities. Educators are using the IBM PS/2 and multimedia technology to create instructional systems with great versatility and power. You can bring lectures and other classroom presentations to life with music, still images, even full-motion video.

A computer system designed specifically for faculty, the Advanced Academic System (AAcS) can be used for scholarly research and writing, lab work, administrative duties and personal work. Most important, you can use it to enrich the teaching and learning experience for your students and yourself. The software on the AAcS lets you use the computer in a more natural, intuitive way—more like people think, not like a programming chore.

The AAcS is an IBM PS/2 computer pre-loaded with off-the-shelf and custom software integrated and adapted specifically for educators. The AAcS was designed by IBM in collaboration with the IAT as well as faculty from across the country. The system allows educators to combine video, still images, text, music, voice and graphics for classroom presentations. It also includes software for word processing, developing spreadsheets, creating graphics and illustrations, writing tests and compiling grades.

Systems such as the AAcS allow you to spark student interest with dynamic multimedia presentations. The interactive classroom experience may be enhanced with tools such as the Classroom Presentation option which includes student response units (handheld keypads linked to the instructor's computer). Using the keypads and a projection unit, you can collect electronic responses from all students, ensuring that every student's voice is heard. This immediate feedback lets you know whether students understand your main point—and reinforces retention of those points.

"Computers let you keep pace with the individual needs of students and prepare them for 'real world' jobs"

In the face of shrinking budgets and competition for funds, is computer technology in the classroom justifiable and desirable? Economic dynamics affecting education today indicate the answer is "yes." New technologies in instruction can offer solutions to the educational and work force preparedness needs of students. In the hands of innovative educators, computers already are changing the nature and content of courses, relieving faculty and teaching assistants of drudgery work so they can teach more, augmenting or replacing expensive laboratories with simulations, giving underprepared students individualized programs to improve their skills, allowing the introduction of new material and concepts often reserved for advanced courses, and providing training that makes a valuable difference in the job market. The number and sophistication of personal-computer-based applications developed for higher education are increasing at a near exponential rate.

The diversity and success of the instructional technology revolution is bringing new learning opportunities to students across the country. Exciting new approaches go significantly beyond "page turning" tutorials. Through personal-computer-based simulations and interactive video programs, students are exposed to experiences that would be too costly, dangerous, or difficult to arrange conventionally.

"Computers can help you make positive, fundamental changes in how you teach"

As educators continue to ponder the learning process and employ available computing tools, students are benefiting. In fact, students at all academic levels respond positively to the new computer technologies. The work of creative educators using instructional technologies is beginning to reshape the learning process on the nation's campuses.

- At MIT, for example, Edwin F. Taylor developed a simulation to help students understand the bizarre world of special relativity. As a result of his work on the program, Taylor acknowledges that his views on relatively and the teaching of relativity have changed considerably.

- At Penn State, Dennis M. Roberts says microcomputers have dramatically transformed the way he teaches statistics. He has shifted the emphasis from "How do you calculate?" to "What are the important questions to ask?"

- At Tulane University, John L. Niklaus says personal computers have caused a leap in

sophistication in civil engineering education there; Clement C. Wilson says it helps students keep up with advances in mechanical engineering at the University of Tennessee.

• At St. Philip's College, 2,500 students a year use a special computer lab to improve basic skills. One of the most significant aspects of creating this developmental program, faculty say, is that they were forced to think more deeply about how learning takes place. Like other educators across the country, they have decided that computers can be a valuable asset in that process.

• At the University of Iowa, faculty no longer need to check homework for 1,200 students taking introductory philosophy. That heavy burden has been lifted by a faculty-developed software package that allows individual student practice.

• At UCLA, more than 500 students taking elementary symbolic logic use a personal-computer-based workbook that eliminates homework grading and frees teaching assistants to work with students.

"Computers benefit nearly every aspect of faculty work"

In addition to the use of computers in a lecture or presentation setting, they also can be used to prepare syllabi, class notes, compile grades, lab manuals, tutorials, simulations, drill-and-practice exercises and multimedia presentation. The beauty of using the current generation of computers is that easy-to-use tools are available for the novice or the expert.

Syllabi, Class Notes and Lab Manuals

Using a word processor, you can make your course material available to students. You are probably already doing this. If you take advantage of a local area network (LAN), you can make this material available to whomever you want, whenever and wherever they choose. The benefits of utilizing a network are quite numerous, not the least of which is eliminating duplication costs and pounds of paper.

Many word processors, such as Microsoft Word for Windows, allow you to make your documents look like they were compiled on a desktop publishing system. You can use images and graphics from other applications or a scanner to make your documents look even better.

Using the annotation features of Microsoft Word, your students can incorporate their own notes and/or questions into class notes you made accessible, either via a diskette or on a network. You can easily imagine that these notes could become an on-going personal reference book that students can use as they matriculate.

Exams

Only a teacher knows how much effort goes into writing good test questions and how painstakingly exams are designed and assembled. Using an IBM-exclusive feature, the Test Generator, teachers can use a word processor to file test questions for future use, categorize questions, set the level of difficulty and generate customized tests, complete with instructions. In addition, the Test Generator can print answer keys so you can provide immediate feedback for students.

To use the Test Generator, you use a special feature built into Microsoft Word. The Test Generator allows you to choose whether you wish to enter a multiple choice, true/false or fill-in-the-blank question. You may add a category and sub-category to your question as well as a level of difficulty. Once the questions are stored you can create an exam by specifying the number of questions for each category, sub-category and difficulty level. In case you teach multiple sections of a course or use more than one version of each exam, you will find the Test Generator creates multiple forms, effortlessly. All in all, the Test Generator can make it easier for you to create high quality exams, covering the course content of your choice.

Tutorials

Most teachers find mixed ability levels in a class. Self-paced study modules or tutorials may help you establish a common base of understanding within your class. Computerizing these modules allows you to provide needed assistance to individual students, no matter how hectic your schedule. Some teachers create tutorials to provide students with enrichment experiences, when the student has the time or motivation to make use of them.

If your students have access to a computer lab or study center, these tutorials can be made available via diskettes or a network. Using software such as ToolBook, you can provide text, graphics, images, animation, even full-motion video in your tutorials. You may design your ToolBook to allow students to select their own path through the material (hypertext) or, you can structure their discovery process. Questions and other forms of interactivity can be interspersed.

Drill-and-Practice

In many subjects, practice is essential for mastery of concepts and skills. Computers allow you to make drill-and-practice available to students with less overall effort than worksheets and can make practice sessions more engaging for students. An additional benefit is that the computer can customize practice sessions by generating a unique set of exercises for each student. These programs may be designed to advance students to more difficult problems only after they have mastered the fundamentals. You may also choose to have the computer keep a record of student progress, time-on-task, or other factors relevant to teaching and learning.

Simulations

Simulations allow students to experience situations that may be too time consuming, expensive or dangerous to deal with in real life. A chemistry simulation, using multimedia, can show an explosion in a grain elevator caused by the spontaneous combustion of grain dust or the reaction of toxic elements. Even though these events may add dramatically to a student's understanding, neither experience would be feasible without computer simulation. In other cases, a spreadsheet may be used to create a simulation of buying and selling commodities on the futures market. Experiences such as these provide graphic, memorable impressions and add to student learning and motivation.

Simulations are valuable in lecture, lab or in study centers. They may be based on common tools, such as a spreadsheet, animation features of programs such as ToolBook or might rely on multimedia. Whether you choose to develop your own or acquire simulations, they can add interest and enjoyment to mastering a subject.

Grades

To help you manage grades, IBM has made the Gradebook available to faculty as a part of the system described earlier, the Advanced Academic System. The Gradebook was requested by

faculty as a means of making recordkeeping easier, more accurate and timely. If you prefer, you could construct your own using a spreadsheet.

With the Gradebook, you can enter a class roster, identification numbers, homework, quizzes, labs, exams and more. You set the grading scale by selecting among pre-programmed options or entering your own. Grades will be automatically tabulated, recalculated and displayed in a number of formats (e.g., alphabetical). No programming is required; only minimal word processing skills are needed.

The Gradebook can make it easier to respond to student questions such as "What is my grade now?" or "What do I need to make on the final?" or "Where do I rank in class?" With a click of the mouse button, you can respond to these individual questions.

Overheads and Slides

For many of your presentations, whether in class or at a professional meeting, slides or overheads are desirable. Several programs are available to help you prepare colorful—even dramatic—presentations. You may choose your output as overheads, slides or a projected computer image. One such tool is Hollywood. Hollywood is based on Windows, so what you have already learned about using Windows will apply. Options on colors, type styles, size, etc., are available from the menu bar that appears at the top of your screen. All you need to do is click to make your choice. Several templates also are included for outline style presentations, use of bullets, title slides, etc. If you know some word processing, the rest is not difficult to learn.

To create overheads, you will need a printer. For slides, you can send a diskette with your material to many vendors for them to develop the slides. You can even send your slide material direct from your computer via a modem and phone line. If you choose to project images from your computer, you may organize your charts just as if you were sorting slides. The computer will remember to display them in the order you choose. Of course, you can alter the order of the presentation as often as you like.

"Computers make the learning experience for students richer and more interactive"

Just as teachers benefit from computers in a wide variety of ways, so too do students. Computers require that the student interact with the program, making them an active participant in their own learning process. In a lab setting, computers allow the student to progress through the material at his or her own pace and can provide valuable evaluation and feedback to student responses. Because of the "hypertext" capacity of computers, students also can branch to various levels and difficulties of work, rather than having to proceed through the material in a linear "front to back" fashion.

The term hypertext was originally introduced in the early 1960's by Ted Nelson to mean "non-sequential writing." Text written this way is not read from beginning to end, rather the text contains junction points where the reader may branch at will into supplemental materials. Individual words in a journal article, for example, may be keyed to pictures or additional text. As an individual at the computer reads an article, he or she can stop at a word or phrase of interest and immediately access additional, related information.

In traditional text, the reader must follow a single track of thought. If one skips around in a book, or if one stops to look up other information, it is often difficult to go back to the starting point. Now that a great deal of text is presented by computer screens, the computer is able to manage the wanderings of the reader.

With the arrival of hypertext, it is no longer necessary to read text in a sequential manner. A concept that is presented in one document can readily be linked to associated concepts in other documents. In addition, hypertext allows text to compete with visuals, sound and data related to the concept. Text, numeric data, still images, motion images and sound can all be stored and cross-referenced in hypertext. Fields or buttons are created to identify an item that may be selected for branching. From a button, you might branch to an audio recording, full motion video or a definition.

Students also can return to and repeat a lesson as many times as necessary to understand the concepts presented. These advantages, and the very captivating nature of many of the software products now available, motivate the student to become a more willing and enthusiastic learner. Hypermedia programs are already being used at schools across the country to enhance the learning process:

- At the University of Illinois, approximately 3,000 general chemistry students a year perform simulated "wet" lab experiments on IBM workstations linked to an interactive videodisc system which allows them to see video of the experiments and control how the experiment is conducted. Better experiments and more skills training have been added without increasing course time, and student test scores have improved.

- At the University of North Carolina, undergraduate psychology students gain clinical experience by carrying out simulated interviews with a troubled person, as shown on videodisc. The students are overwhelmingly enthusiastic about the simulation, and the quality of their reports compares to those of graduate students.

- The Harvard Law School has turned to interactive videodisc exercises to bridge the gap between the classroom and actual practice. Action-oriented simulations challenge students to practice their "lawyering" skills in realistic scenarios.

- Medical students at the University of Iowa, using an interactive videodisc program, are learning to recognize disabilities in children.

"The many benefits of technology make it a sound investment for your time and resources"

Many educators ask "Is it really worthwhile to use computers in teaching? Overwhelmingly, the evidence says "yes," particularly when you consider the many ways they can make teaching more efficient and effective.

According to a 1990 Department of Defense study, computer-based interactive video improves achievement by 50 percent over conventional instruction. The time to reach competency is reduced by one-third. In nearly every case, interactive video was found to be less costly than conventional instruction.

Among the advantages of using computers in teaching are:

<u>Self-pacing by the student</u>

A student who does not immediately grasp a concept, or who chooses to spend more time analyzing and associating it with related concepts, need not be neglected or inconvenienced by

being hurried along, as he or she might be in a classroom environment. A student who feels no need to dwell on a particular point can move along to more interesting material. In either case, a student can choose to go back over subject matter previously covered or skipped; or a student can look ahead, and even select the order of presentation.

Teacher-student dialog

Interactive learning is a close approximation of one-on-one teaching. In effect, the student has the benefit of the teacher's attention to his learning needs exclusively. In effect, the teacher, working through the system, has the benefit of individual feedback on the effectiveness of his or her presentation.

Achieving mastery

It is no longer necessary to accept less than mastery of the subject matter as the goal of the teach-student interaction. A properly designed interactive learning system will permit a student to easily close any gaps in his or her understanding of the material, or to eliminate erroneous concepts, without the possibility of humiliation or discouragement.

Teacher in top form

The teacher never has an "off day" with a properly prepared interactive learning presentation. Each segment of the presentation is the result of careful planning, preparation and development. A superior presentation might represent the culmination of years of effort on the part of a teacher. Every student who uses the system benefits from the flawless performance.

No media limitation

In the idea interactive learning environment, there is a broad mix of media appropriate to the subject matter used in the presentation. There may be high fidelity stereo sound, high resolution linear video, high density still-frame photography or even kinesthetic stimuli. Printed text might be a supplementary, if not the primary medium.

Less time required

Experience in the armed forces indicates that a time savings of 30 percent is not uncommon through the use of interactive learning systems. This time savings can also result in cost reductions.

Simulations are possible

Interactive learning environments can offer opportunities to simulate otherwise dangerous or expensive real-life conditions and situations. Examples are flight simulators and simulations of nuclear power plant control rooms. But perhaps more important, there is evidence that more prosaic subject matter might be more easily and more permanently understood if it is literally "explored" in a simulation mode.

"You don't need to be a computer wiz to use the technology"

If you are concerned about how much technical understanding you must have to use this technology, you can relax. You probably don't need to know a great deal more than you know right now, if any. The most critical skills in using computers in instruction are understanding the

course content and how to organize it. Those are skills you already possess. In addition, you should know how to use a word processor. It is helpful if you are familiar with a mouse and Windows. If you don't know how to use them, its a snap to learn.

Much of the IBM-compatible software developed for higher education is based on Windows and its graphical user interface (sometimes called what-you-see-is-what-you-get). This means that you choose commands from a menu—there is no need to remember codes or type strings of characters. Once you have learned one Windows program, you will find others easy to master because their "look and feel" is very similar. This not only makes it easier for you—it's a big time saver. You don't need to start from scratch when you learn a new program—most of your skills will transfer.

In the last two years, computer systems have been made available which are pre-loaded with software and ready to use as soon as you plug them in and turn them on. This saves you the time and trouble of selecting among hundreds of software products, deciding which are compatible with what hardware as well as installing and configuring both the hardware and software. The reason for this move is obvious. Your time is valuable. You should be able to apply your skills creatively in your discipline, not learn to be a computer specialist. Faculty across the country requested this option. It is now available.

Toward the future

Change isn't always welcomed, nor is it easily achieved. Yet, the rapid evolution of innovative educational technologies provides us with the necessarily unique and powerful tools we need to better stimulate and assist today's learner. With these tools we can provide for our students the knowledge and skills they will need to enter today's increasingly competitive, global workforce. These tools are available now, we need only to take advantage of them.

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The Author

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About the Institute for Academic Technology

The IAT is a national institute working to place higher education at the forefront of academic technology development and implementation. Operated by the University of North Carolina at Chapel Hill and funded through a grant from the IBM Corporation, the IAT strives to facilitate widespread use of effective and affordable technologies in higher education. To that end, the IAT conducts a number of briefings, workshops and planning sessions to keep academics informed about available technologies and to help explore the use of technology on individual campuses. For more information, contact:

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